



Instrumented Borehole Deploying Water Flux Meter and Advanced Tensiometer

The Challenge

Sixty-seven of Hanford's 149 single-shell tanks have leaked or are assumed to have leaked about one million gallons of highly radioactive and hazardous waste into the ground. There is evidence the contamination has impacted the groundwater. There are concerns the contamination could eventually reach the nearby Columbia River.

The Government Accounting Office (GAO) reported in March 1998 that DOE's understanding of how contamination moves through the vadose zone to the groundwater is inadequate to make key technical decisions on how to clean up the contamination at the Hanford Site. A June 2000 report by Pacific Northwest National Laboratory (PNNL) stated that additional information is needed about the processes controlling transport beneath Hanford tank farms. On July 10, 1998, Ecology requested that DOE develop and submit a corrective action plan for four tank farm areas with documented leaks (S-SX, B-BX-BY, T, and TX-TY).

The River Protection Project - Vadose Zone began efforts to characterize and evaluate the implications of tank wastes released to the environment. The project is implementing a RCRA field investigation to provide the information that will define and support appropriate corrective measures.

Current Approach

The conventional technology for subsurface characterization is drilling a borehole, collecting soil samples during drilling, and analyzing the samples in a laboratory. The borehole is backfilled and abandoned after sampling. A new borehole is drilled if additional information is needed at a later time.

New Technology

The new Vadose Zone Monitoring System (VZMS) continuously measures soil water pressure, water content, and temperature in a 265-ft borehole instrumented with eight sets of



Vadose Zone Monitoring System before Deployment in B Farm

BENEFITS AND FEATURES

- ◆ Advanced tensiometers, developed at the Idaho National Engineering and Environmental Laboratory (INEEL) are robust
- ◆ Water flux meter key to infiltration or drainage measurement
- ◆ Vadose Zone Monitoring System (VZMS) helps determine the actual rate of contamination movement toward the groundwater
- ◆ Improved understanding of vadose zone parameters affecting contaminant fate and transport help perform risk assessments

sensors. During July and August 2001, the instrumented borehole was deployed in the B tank farm in a well located adjacent to Tank B-110. Duratek Federal Services drilled the 0.2-m (0.66-ft) diameter borehole under the direction of CH2M HILL Hanford Group, Inc. (CHG). The borehole was steel cased with bentonite and sand at the bottom.

A VZMS assembly was lowered to a depth of 76 m (232 ft) bgs. It included advanced tensiometer and heat-dissipation probes to measure soil water pressure and monitor for possible perched water zones. Sensors were included to measure soil temperature and moisture content. The water-content sensor was set against the borehole wall using its attached lever arm. Seating the sensor against the wall was monitored by a down-hole video system.

Once the VZMS was placed satisfactorily, the assembly was grouted in place with a silica flour slurry. The slurry was allowed to settle a few minutes, after which a sand plug was added. A bentonite sealant was then placed up to the next selected instrument level. This process was repeated up to the 6.2-m (20.4-ft) bgs depth, where the backfill materials were switched to sand and native materials. A water flux meter, installed at 6 m (20 ft) bgs and extending to within 20 cm (8 in.) of ground surface, measured infiltration or drainage. A data logger was installed on the surface to collect and store the field data.

The B Farm installation is the first VZMS in Hanford sands and gravels. Information gained from this installation will guide electrode geometry modifications to better track water

content changes. A preliminary data examination from the B110 borehole indicates abnormally high water content readings at the 66.4- and 68.9-m (218-, and 226-ft) depths. These high water content zones were also noted during drilling and on geophysical logs of the borehole, confirming drilling observations.

As many as a dozen boreholes may be drilled and fitted with instruments as part of the Vadose Zone Characterization Project. The borehole deployment cost is about \$39,000. Anticipated monitoring per borehole will cost about \$25,000 per annum. The lifetime of the instrumented borehole is 10 years. Cost of drilling another hole is estimated at \$500,000. Sampling and analysis will cost another \$250,000. The return on investment is over 100% if the drilling of one borehole is avoided over the next 10 years as a result of this deployment.

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